Traffic, Asthma, and Lung Development
Living Near Busy Roads:
What do the health studies tell us?

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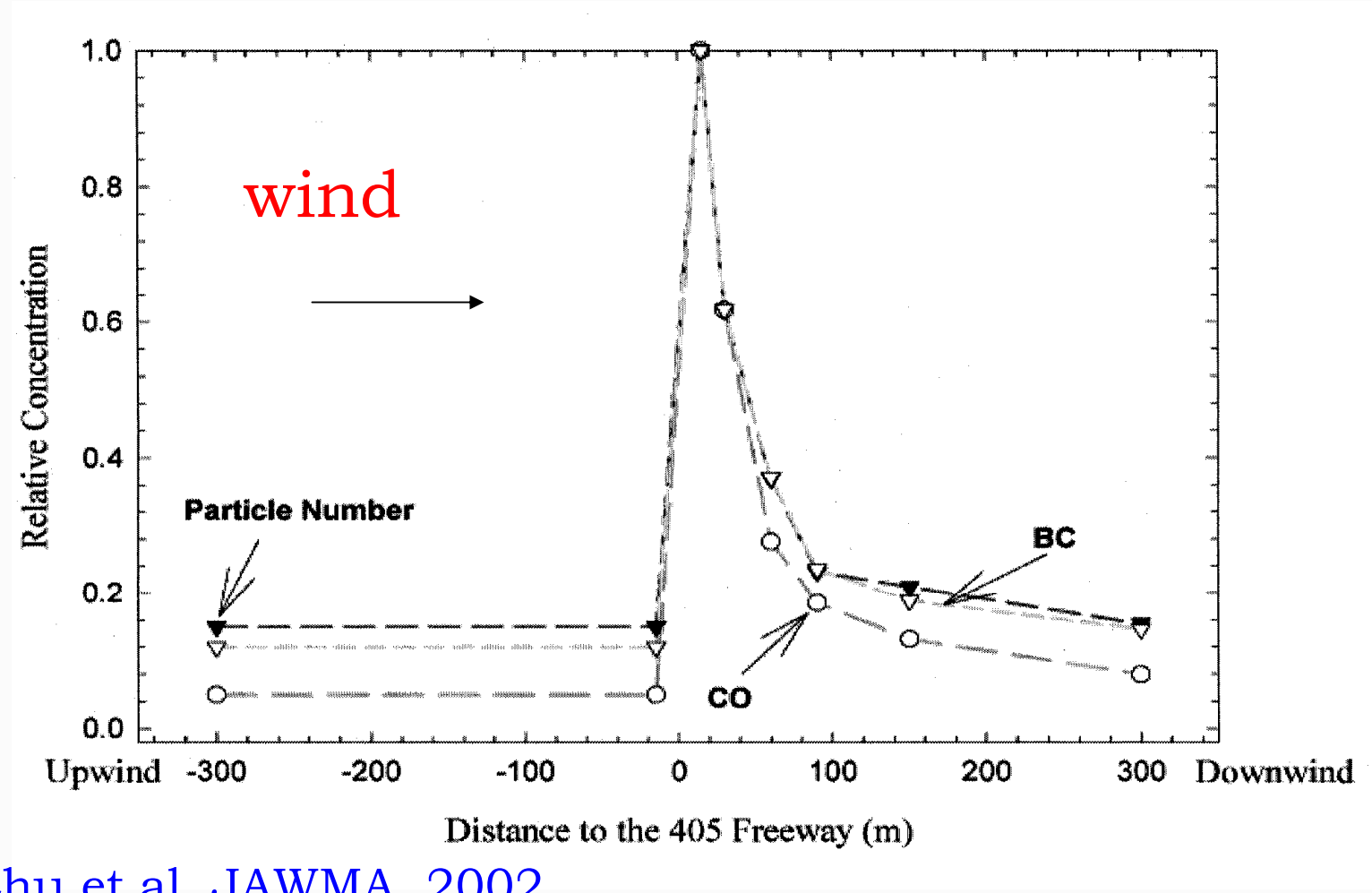
Overview

- Introduction- traffic related pollution
- East Bay Children's Respiratory Health Study – an example
- Other Studies on Health Effects of Living Near Busy Roads
- Policy Implications

Background

- Air pollution affects health
  - respiratory, cardiovascular, cancer, birth
  - regional air monitors often used to estimate exposures
- Traffic-related emissions-major source of air pollution in urban area
  - Contains many pollutants: (gases eg. NO2, ultrafine diesel particles, other toxic air contaminants e.g. acrolein, formaldehyde, benzene, 1,3 butadiene)
  - Includes: respiratory irritants, carcinogens
  - Laboratory studies: diesel gases and oxidant gases enhance IgE response

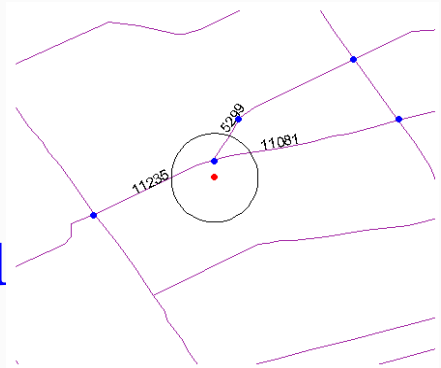
Traffic-related pollution: higher near and downwind of busy roads



Zhu et al. JAWMA, 2002.

Respiratory Health & Proximity to Traffic

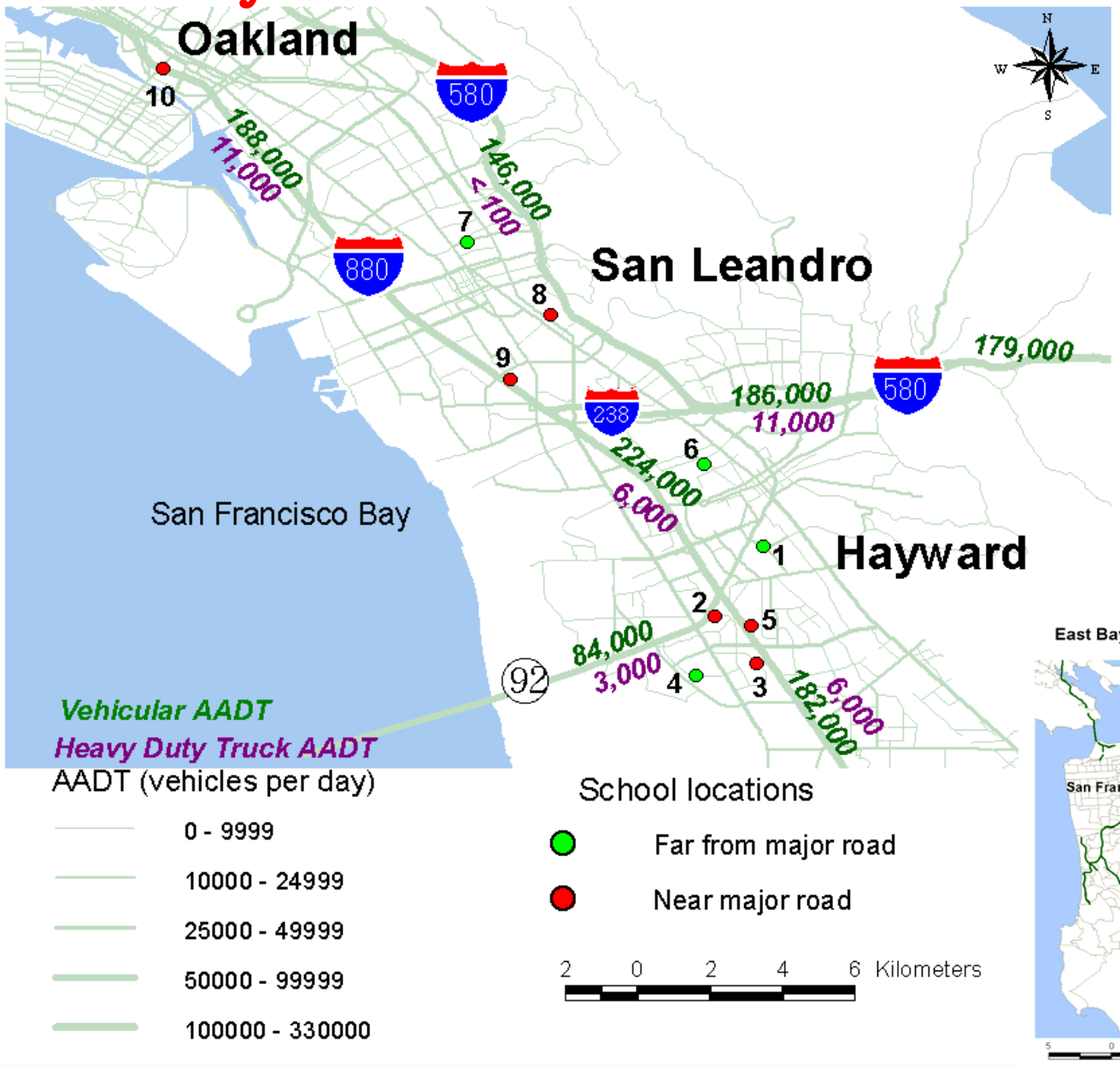
- Over 40 epidemiological studies–many in children many in Europe but also US - ?? Applicable in CA
- Measures of traffic exposure
  - Self report
  - Distance to/traffic counts nearby road
  - Spatial model/measured pollutants



- Some health outcomes associated with traffic exposure
  - Increased respiratory symptoms (wheezing, cough)
  - Increased hospital admissions for asthma
  - Decreases in lung function

East Bay Children's Respiratory Health Study – an example

OEHHA: East Bay Children's Respiratory Health Study



Regional Air Quality

PM2.5 13.9 μg/m^3

PM10 21.8 μg/m^3

Ozone 0.081 ppm (8-hr max)

East Bay Children's Respiratory Health Study area

East Bay Children's Respiratory Health Study: Part 1 Kim et al., Am J Resp Crit Care Med 2004,170:520-526

- **1111 children in Alameda County:**
  - **10 elementary schools varying distance from freeway. Health questionnaire, monitored neighborhood levels of traffic pollutants at school- fall & spring**
  - **Multivariate logistic regression analysis**

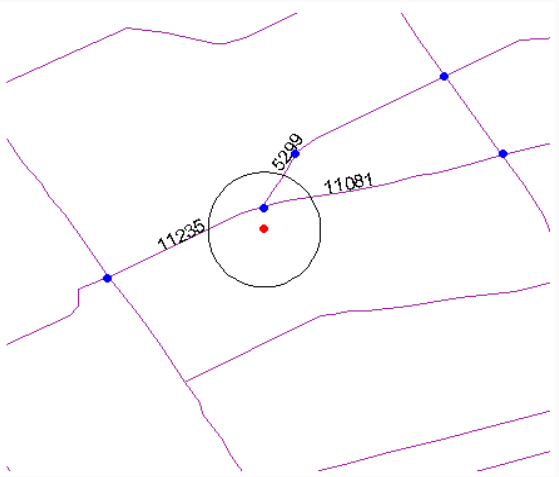
- **In an area with good regional air quality:**
  - **Levels of traffic pollutants up to 1.5 to 2x higher at locations near & downwind of freeway.**
  - **Children from schools/neighborhoods with ↑ levels of traffic pollutants have an ↑ risk of bronchitis and current asthma**

East Bay Children's Respiratory Health Study – part 2

- Previous study used group level estimates of exposure based on neighborhood (school) levels of traffic pollutants

- Followup study
  - Same study population
  - Estimates traffic exposures on individual level based on traffic near residence
  - Evaluates associations between HOME exposures to nearby traffic and asthma symptoms in the last year

Methods:
Estimates of traffic exposure

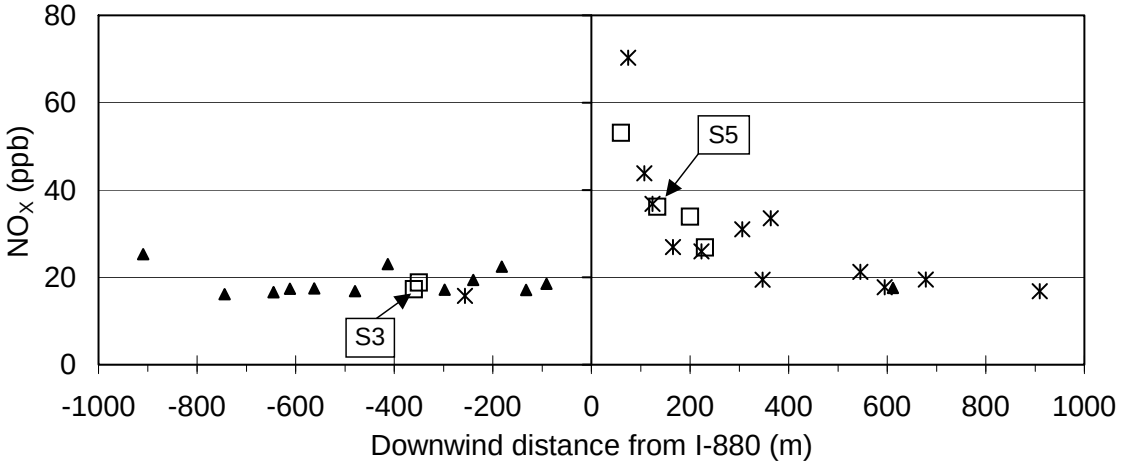


- Development of Metrics:
  - Geo-coded home address
  - Circular buffer radius
  - Tried different Traffic Metrics
    - Highest daily traffic w/in 150 m
    - Traffic on closest road w/in 150 m
    - Traffic density w/in 150 m
    - Distance to major road
- For a subset of locations, determined how well metric correlated with measured levels.

Traffic exposures: measured vs estimated

- Traffic pollutants (NOx, NO2) at 52 outdoor sites (10 schools, 42 locations in 3 neighborhoods)
- Found increased levels of traffic pollutants near & downwind of freeway
- Confirmed computer-generated traffic metrics correlated

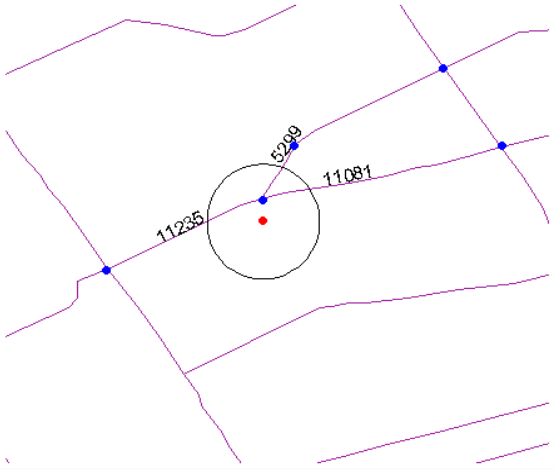
B Singer et al. Atmos Environ 2004; 38:393-403



Methods: Estimates of traffic exposures (continued)

- Developed land use regression model of NO2 to estimate residential outdoor NO2

  – model variables evaluated included:
    - traffic density within given radius
    - wind direction
    - land use indicator
    - urban impervious factor



Methods: (continued)

- Health outcome
  - Current asthma (history of doctor's diagnosed asthma and asthma symptoms within last 12 months based on health questionnaire)

- Health analysis: mult-variate logistic regression
- Examine associations between residential traffic and current asthma
  - Model covariates evaluated included risk factors previously identified

    such as: (e.g., famiily history of asthma, demographics, early childhood factors, health insurance status and home environmental factors e.g. smoking in home, mold, pets, etc)

Results:

- Higher rates of asthma symptoms with increasing residential traffic:
  - Odds of asthma symptoms (highest 20% vs lowest 20%) adjusted for family hx, home environmental factors, demographics)

    OR_{adj} : 2.3 (95% CI 1.0, 5.4)
- Highest risks among those living < 75 m of freeway
- Modeled residential NO2 also associated with increased asthma

East Bay Kids Summary

- In a region with good AQ, neighborhood level traffic associated with resp symptoms
- Residential traffic associated with increased risk of current asthma
- Risk greatest for those living within 75 m of a freeway
  - Kim et al. ARJCCM 2004
  - Kim et al. Env Health Perspect 2008

The Team

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- Brett Singer
- Tosh Hotchi

East Bay Kids Partners
- 3 school districts
- 10 schools
- 64 teachers
- parents & kids

Funding
- US EPA Region IX
- CA Air Resources Board

Other CA studies: proximity to traffic and asthma

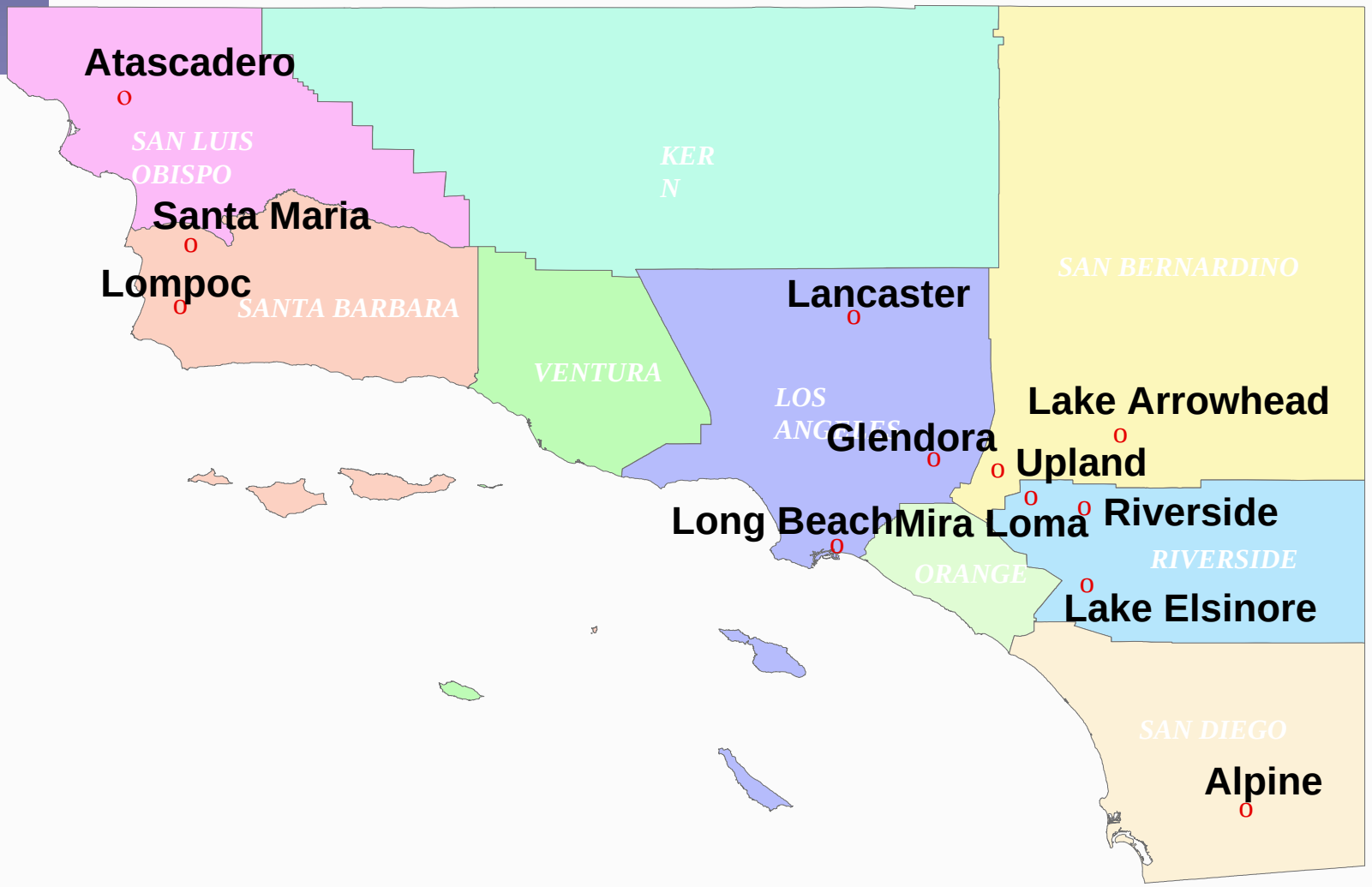
- Increased doctor's visits for asthma among Medical Cal children San Diego County

  Among those with traffic flow >41,000 vehicles/day within 550 ft (160 m) buffer

  (P English et al. Env Health Perspect. 1999)
- Repeated respiratory hospitalizations in asthmatic children living within 300 m of a major road – Orange County

  (Chang et al. Occup Environ Med 2008:66 90-98)

USC Children's Health Study



Other CA studies: proximity to traffic and asthma: USC Children's Health Study

- Gauderman et al., Epidemiology, 2005
  - Subset of children (n= 208) from12 communities
  - Increased risk of asthma ever-diagnosed
    - among those closer to freeway

- McConnell et al., Env Health perspect 2006
  - New cohort – 13 communities in So CA (n >5000
  - Increased risk of life-time & current asthma among those living within 75 m of a major road (freeway/highway/arterial) vs >300 m

Other CA studies: proximity to traffic and lung function

- USC Children's Health Study (Gauderman et al Lancet 2007))
  - Original cohort – 12 communities in So CA
  - Followed lung function yearly for 8 years
  - Compared lung function growth at age 18
    - Previously – those from communities with
      - Higher NO2, PM, acid vapor had higher percentage with deficits in lung function e.g. FEV1
    - **This study- those within 500 m of freeway**
      - **Had larger deficits in FEV1 and MMEF**

Respiratory Health & Proximity to Traffic – truck vs car

- Dutch study (N Janssen, B Bruekreef et al Env Health Perpect, 2003, 111:1212-1318)

  Children (n=2083) from 24 schools located within 400 m of major roads with a range of car traffic and truck traffic. (Homes < 1km from major roads)

  Resp symptoms, conjuctivitis, and allergy to pollens (skin test) were increased in communities near high *truck* traffic counts but not high car traffic counts

aOR (wheeze) 1.96 (0.88-4.38)	truck traffic
aOR (wheeze) 0.58 (0.27-1.15)	car traffic

Residential proximity to Traffic & Other Adverse Health Impacts

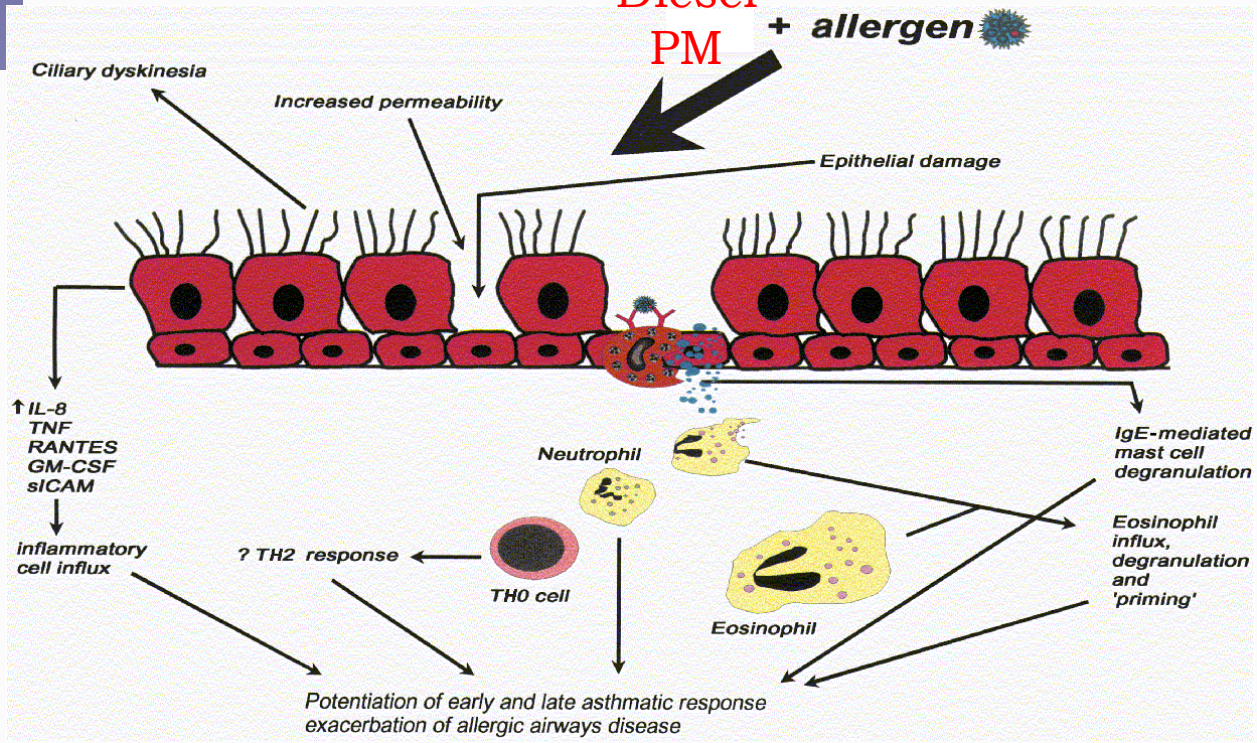
- Newer studies finding links between residential proximity to traffic and
  - death due to heart or lung disease (Netherlands)
  - stroke (UK)
  - cancer (Sweden, Denmark, US)
  - premature births (Los Angeles, CA, Wilhelm & Ritz –

Respiratory effects of short term exposure to diesel traffic in asthmatics

- Randomized, crossover study of 60 mild to moderate asthmatic adults in London McCreanor et al. NEJM 2007
  - 2 hr walk along Oxford Street- diesel traffic only or 2 hr walk Hyde Park on a separate day
- Measured-traffic pollution exposures (ultrafine and NO2) and lung function and biomarkers of inflammation
- Outcomes after Oxford walks compared with Hyde Park walks
  - Oxford walks- higher traffic pollution
    - small but significant decreased FEV1 and FVC up to 22 h after exposure
    - increase in sputum myeloperoxidase

Proposed mechanism- role of traffic pollutants in enhance allergic response

NO2 + Diesel PM



Krishna & Holgate

1999

- NO2, DEP enhances recall IgE response in sensitized individuals
- DEP Induces an IgE response to new antigen

Traffic pollution genetics and asthma and lung development in children

- USC Children's health study
- TGF—beta 1 variants associated with lifetime asthma. Effect increased in those living within 500 m of freeway
- glutahione S-transferase (GST) and microsomal epoxide hydrolase (EPHX) increase susceptbility to development of asthma. Effects greatest among those <75 m from a major road

Salam et al. AJRCCM 2007

Salam et al. Thorax 2007

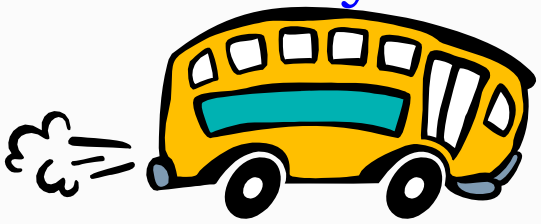
Sandstrom and Kelley editorial Thorax 2009

California's Children: Proximity to Traffic

Children live & play near busy roads

(photo, courtesy A Hricko, USC)

Schools are located near busy roads



High exposure in traffic & diesel school buses

California's Children: Proximity to Traffic & Environmental Justice

- CDHS study: RB Gunier et al. J Expo Anal Environ Epidemiol. 2003
  - In CA– children of low income & children of color 3X more likely to live in high-traffic density areas

- OEHHA study RS Green et al, Environ Health Perspect 2004
  - Proximity of CA public schools to busy roads
  - Schools located near busy roads have a disproportionate number of children economically disadvantaged and nonwhite

Proximity to traffic & health risks, information for policy makers

- OEHHA/DHS/ARB traffic fact sheets:
  - Air Pollution from Nearby Traffic and Children's Health: Information for Parents & Schools

    http://www.oehha.ca.gov/public_info/public/kids/airkidshome.html
- CA legislation enacted January 2004
  - SB 352 (Escutia) limits new school sites within 500 ft. (168 m) of a freeway
- Air Resources Board (ARB) efforts
  - focus on diesel emissions reduction
  - limit diesel idling near schools/residences

Proximity to traffic & health risks, information for policy makers (cont)

- Land use decisions often made by local government
  - ARB guidance document: Air Quality and Land Use Handbook: A Community Health Perspective." www.arb.ca.gov/ch/landuse.htm
  - San Francisco Board adopts air pollution hot spot rule November 2008
    - Requires developers to take into account traffic in CEQA
    - Requires mitigation (HVAC) if a traffic model of PM2.5 exceeds 0.2 mcg/m3 over ambient

Proximity to traffic & health: some unresolved issues

- Levels of traffic pollutants on some high traffic streets may equal levels near freeways – what constitutes a "busy road" –risks difficult to quantify
- Source control: traffic exhaust, a complex mixture
  - What pollutant (s) are causing health impacts
- Ongoing studies to evaluate role of ventillation filtration systems to reduce exposures

Thank You!